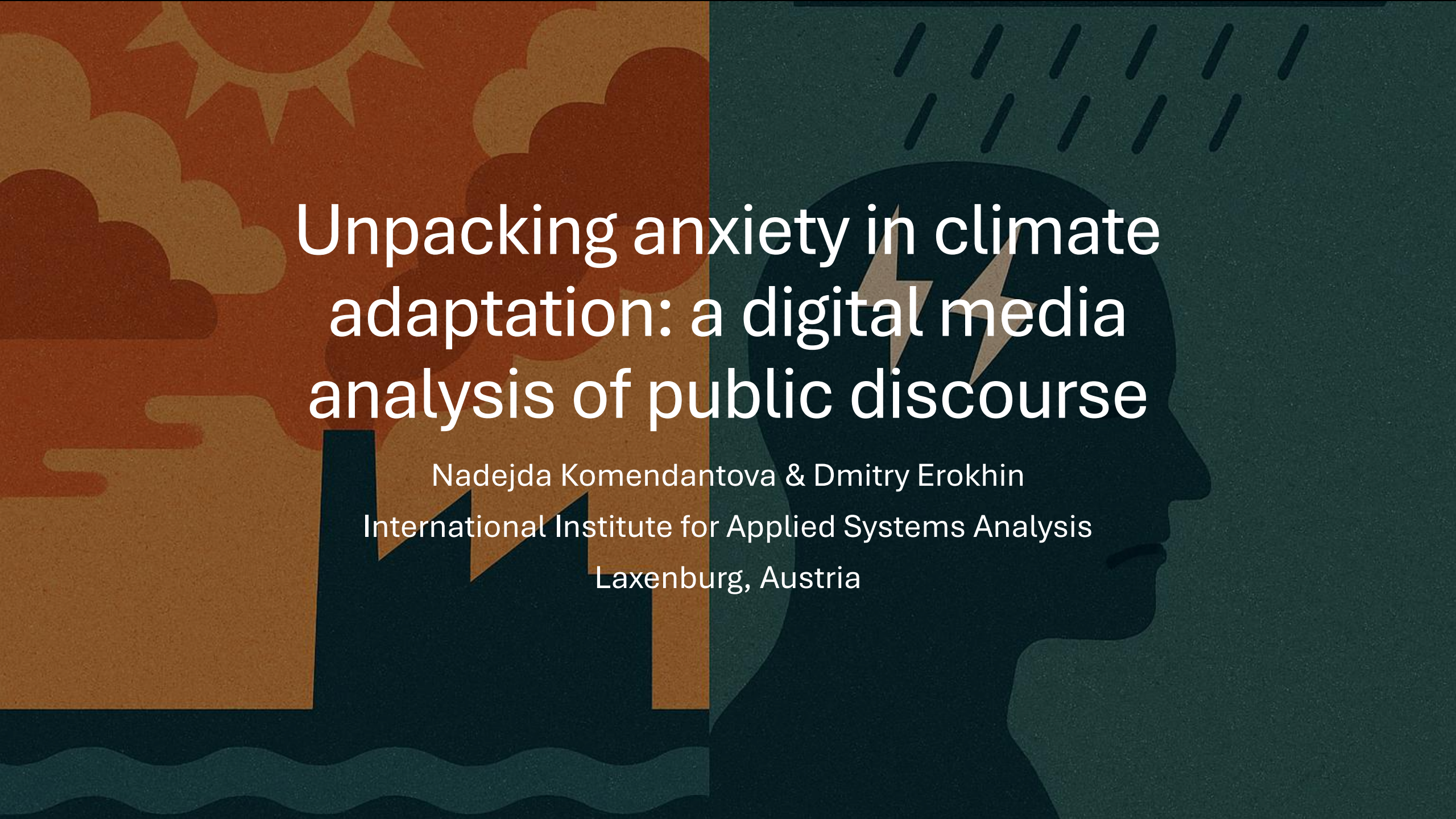


The background is a stylized illustration. The left side features a warm orange and brown color palette with a sun, clouds, and a factory silhouette. The right side is a dark teal color with a silhouette of a human head in profile, containing a lightning bolt, and rain falling above it. The title text is centered across both halves.

Unpacking anxiety in climate adaptation: a digital media analysis of public discourse

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Introduction

Overview: In the era of accelerating climate change, digital platforms like YouTube are not just sources of information, they are spaces where emotions, narratives, and ideologies collide. As climate adaptation becomes more urgent, understanding how online discourse shapes public sentiment is crucial.

Context: Social media platforms significantly shape public perceptions and attitudes toward climate change. They function as arenas of both collective solidarity and polarized debate.

Research Question: Does social media discourse around climate change foster societal solidarity or deepen polarization?

Aim of the Study: This research examines the emotional dynamics and stances on misinformation in YouTube comment sections. It seeks to uncover how public discourse around climate adaptation may either build collective engagement or trigger division, particularly through expressions of anxiety.

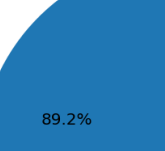
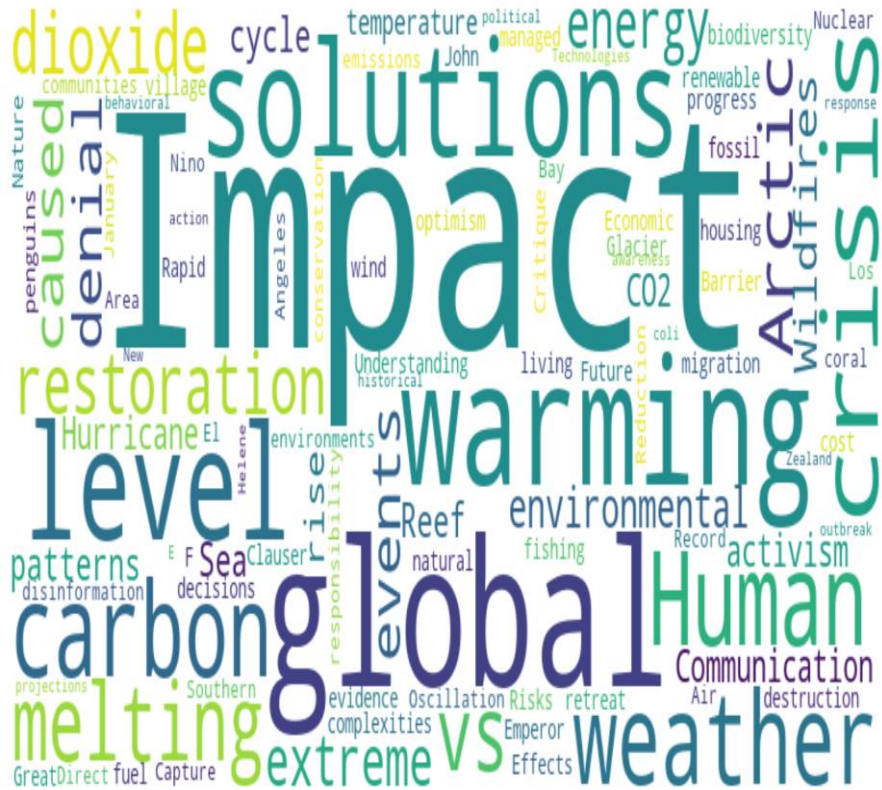
Structure

- **Part 1:** General overview of emotional patterns and polarization in climate discourse
- **Part 2:** A focused analysis of **anxiety-related comments** and their social meaning

Methodology

- 74 English language videos most relevant to the search query of “climate change” with comments extracted from YouTube on April 16, 2025 using YouTube API.
 - Views : 1 100 to 13 714 014 (mean: 1 460 616.54, std: 2 695 756.00);
 - Published from 2014-04-22 to 2025-03-25. Most videos published: 2024-10:7 videos; 2025-03: 7 videos.
- 334 708 comments extracted for these videos.
 - Likes: 0 to 69 416 (mean: 7.26, std: 255.68);
 - Responses: 0 to 756 (mean: 0.68, std: 7.40);
 - Published from 2014-04-22 to 2025-03-25. Top 5 months by comment count: 2021-09: 40 053 comments; 2022-04: 26 837 comments; 2020-06: 25 734 comments; 2024-01: 22 800 comments; 2023-09: 18 569 comments.
- OpenAI API model gpt-4o-mini used to process the comments.
- Potential limitations: representativeness of selected videos, platform-specific trends and algorithmic filtering, limitations of OpenAI API model.

Part 1: General overview of emotional patterns and polarization in climate discourse



Frequency	Percentage
Often	89.2%
Not often	10.8%

Response	Percentage
none	89.2%
opposes	9.5%
supports	1.4%

A pie chart illustrating the distribution of responses for the statement "Solidarity is a good thing". The chart is divided into three segments: a large blue segment representing "solidarity" at 45.9%, an orange segment representing "none" at 31.1%, and a green segment representing "polarizing" at 23.0%.

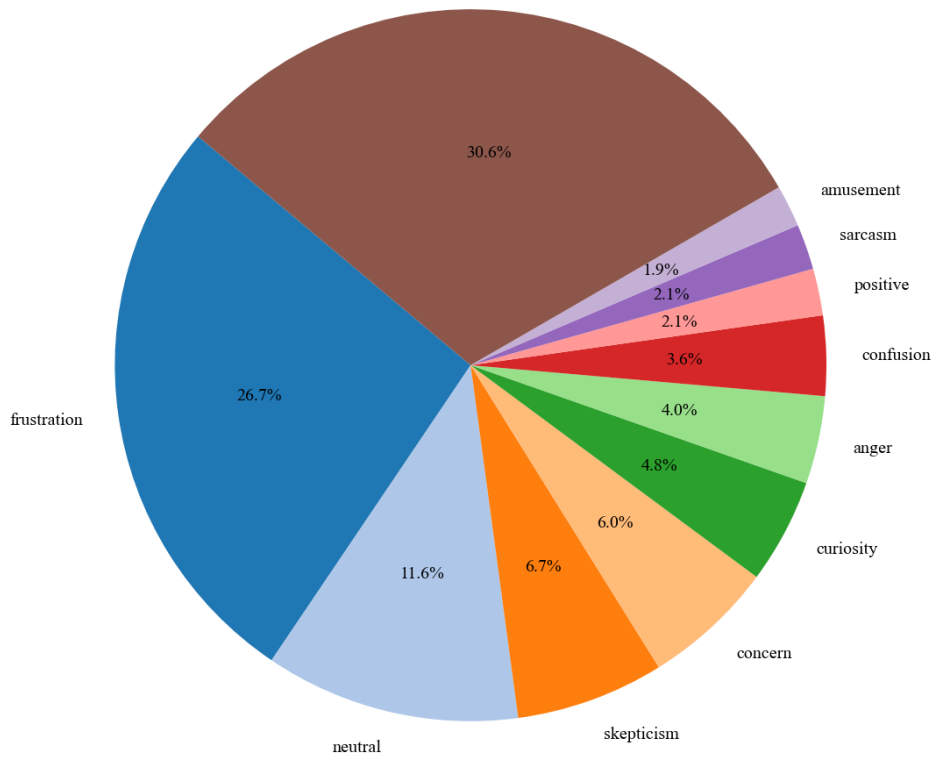
Response	Percentage
solidarity	45.9%
none	31.1%
polarizing	23.0%

A histogram showing the distribution of sentiment scores. The x-axis is labeled 'Sentiment Score' and ranges from -0.75 to 0.75 with major ticks every 0.25. The y-axis is labeled 'Count' and ranges from 0 to 14 with major ticks every 2 units. The bars are blue with black outlines. The distribution is bimodal, with the highest frequency (count of 14) occurring at a sentiment score of -0.75. Other notable peaks are at -0.50 (count 12) and 0.75 (count 9). There is a gap in the data between 0.25 and 0.50, with counts of 3 and 6 respectively.

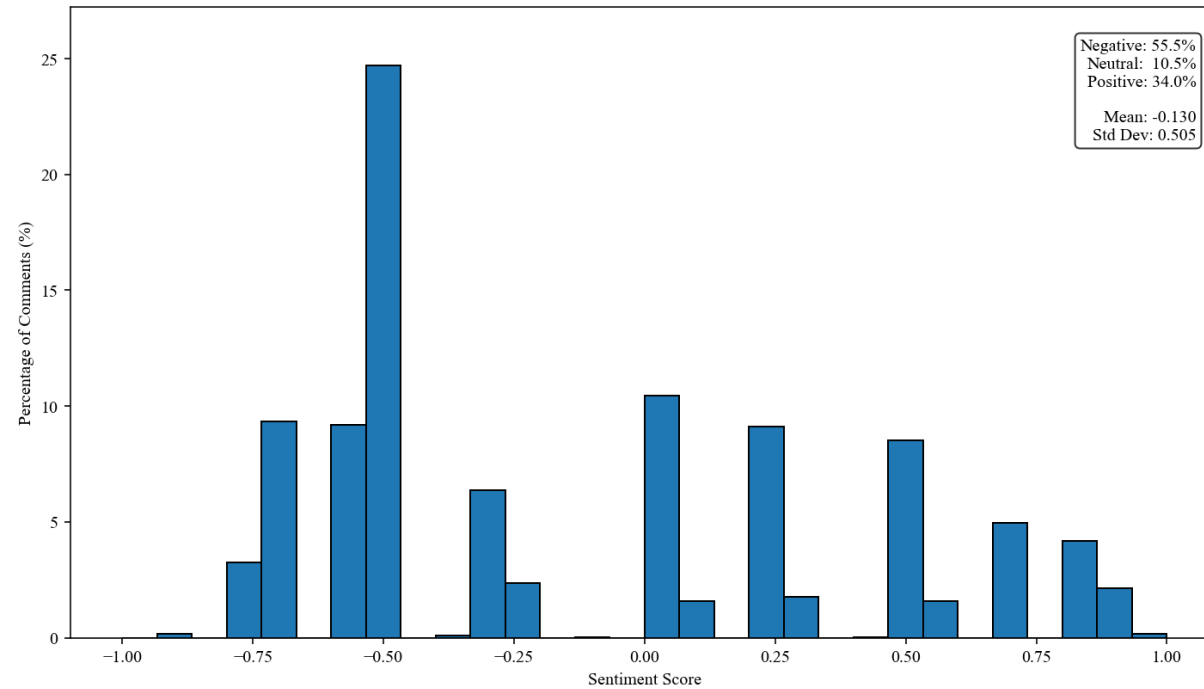
Sentiment Score	Count
-0.75	14
-0.625	7
-0.50	12
-0.375	3
-0.25	6
-0.125	1
0.00	0
0.125	3
0.25	2
0.375	1
0.50	6
0.625	2
0.75	9
0.875	7
1.00	1

Sentiment score and emotions

Distribution of Emotions (Top 10 and Others)



Distribution of Sentiment Scores



Correlation between video sentiment and average comment sentiment:
 $(\rho = 0.368, p = 0.001)$

Most frequent emotions in polarizing and solidarity comments (in %)

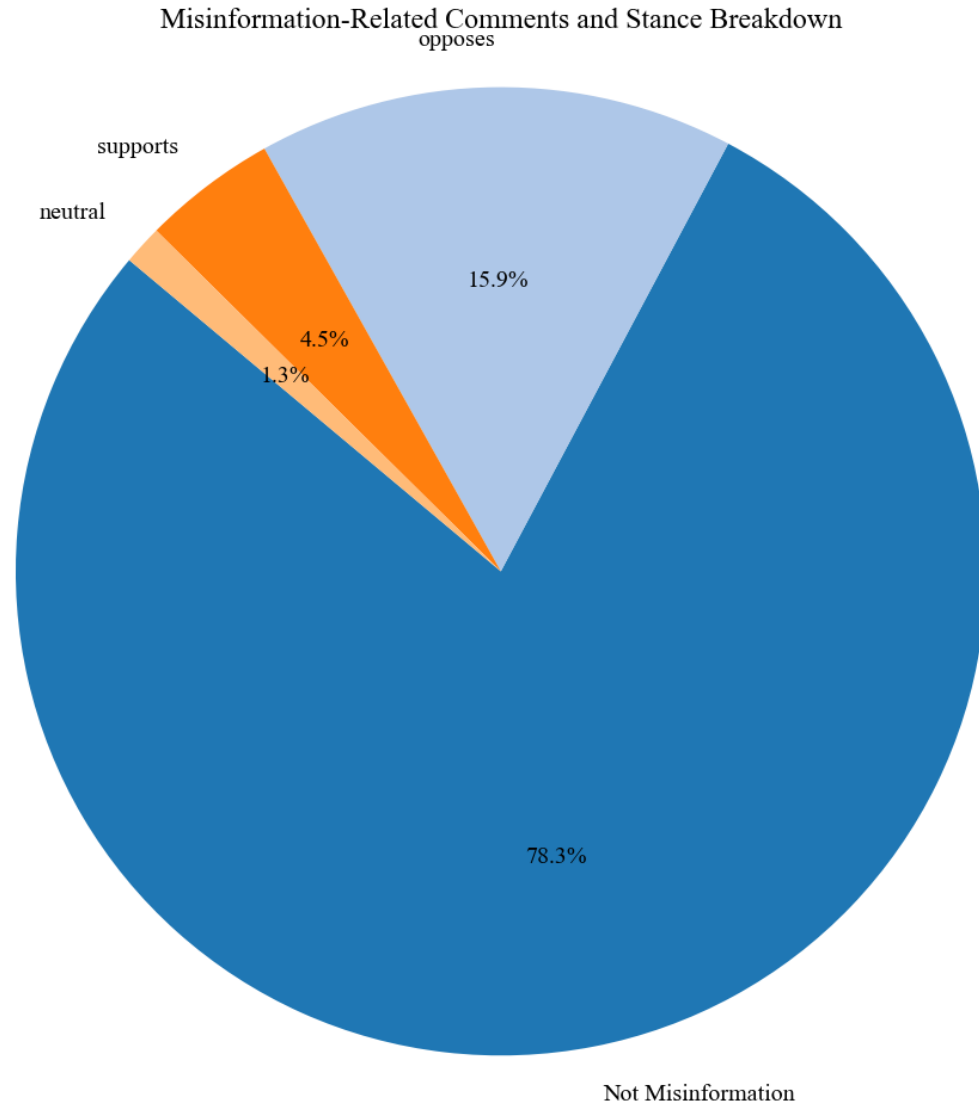
	frustration	skepticism	anger	concern	sarcasm	cynicism	fear	dismissive	discontent	suspicion
polarizing	50.9	15.1	11.1	2.7	3.4	1.9	1.4	1.3	1	0.9

	hope	gratitude	positive	frustration	joy	concern	optimism	agreement	determination
solidarity	18.9	9.5	7.6	6.6	6.2	5.3	5	3.3	3.1

Misinformation stance

Examples of comments (altered for the purpose of anonymity):

- Supporting: Remember climate change is created by CERN.
- Opposing: You should listen to real scientists.

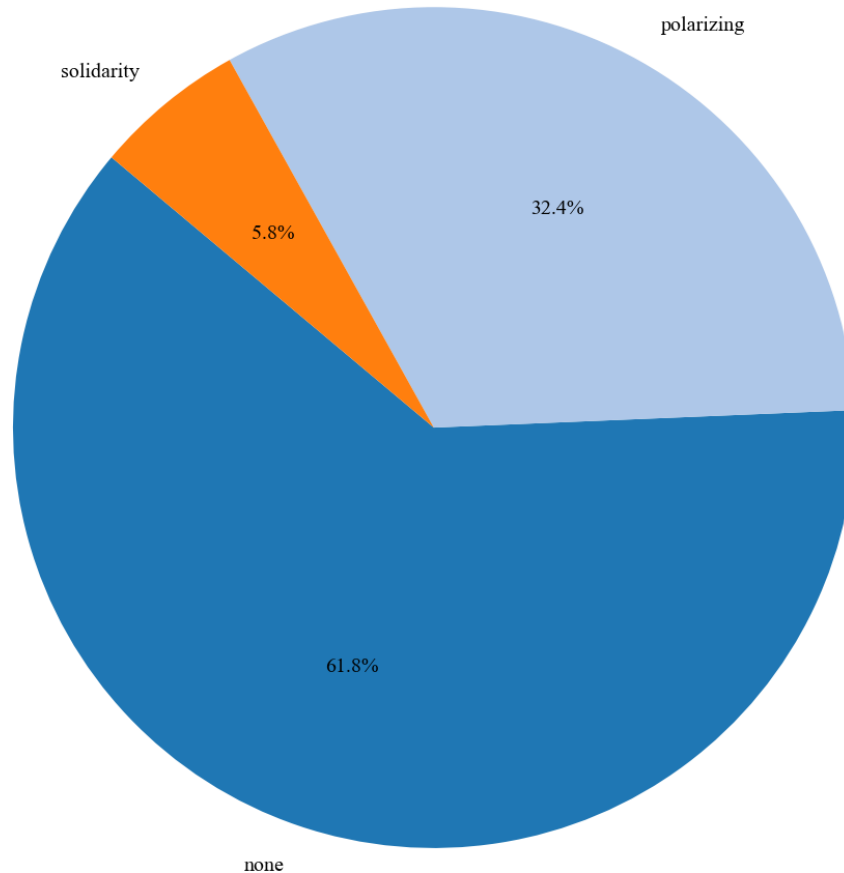


Most frequent misinformation narratives

Narrative category	Example claim	%
Attribution & causality misrepresentation	Climate shifts are entirely natural (sun-cycles, volcanoes, Milanković cycles).	27.83
	CO ₂ is plant food; more of it is good and can't warm the planet anyway.	
Climate change denial	There is no climate crisis – global warming is a hoax.	25.77
Conspiracy theories	Climate is being engineered by chemtrails / HAARP / weather weapons.	24.04
Impact denial / minimization	The claimed impacts (sea-level rise, reef death, extreme weather) aren't happening.	12.78
Delegitimization of science & institutions	Scientists and agencies fake the data.	7.70
	Climate change is a political scam to tax and control the public.	
Others		1.88

Solidarity vs. polarizing

Distribution of Solidarity vs. Polarizing Comments



Examples of comments (altered for the purpose of anonymity):

- Solidarity: Humanity should protect the ecosystem now! 🌍 .
- Polarizing: Climate change is a fake problem created by the UN. It has always changed.

Solidarity claims

Expressions of gratitude and encouragement

- Thank you so much
- Keep up the good/great work
- Thank you for making this video
- I really needed this / I needed to hear this
- Thank you for giving me hope

Calls for collective action

- We all need to fix it
- We can do this / We can fix it
- Need to work together
- Do something about climate change
- We need more people to act

Affirmations of climate science

- Climate change is real
- Scientific consensus on climate change
- Human activity is driving climate change

Solidarity and unity

- We're all in this together
- Every nation on Earth must act
- Part of the solution
- The world a better place

Hope and optimism

- Hope for the future
- Make a difference
- It's not too late
- Breath of fresh air

Polarizing claims

Climate denial and hoax narratives

- Climate change is a hoax/myth/scam
- There is no climate crisis/change
- Climate change isn't real
- Man-made climate change is fake

Natural climate change arguments

- Climate has always been changing
- Climate change is natural
- Coming out of an ice age
- CO₂ is plant food / natural

Rejection of human responsibility

- Has nothing to do with humans
- Man-made climate change isn't real
- Humans aren't responsible
- Nothing to do with CO₂/fossil fuels

Conspiracy and mistrust

- Sponsored by Bill Gates
- Fossil fuel industry propaganda
- Do your own research

Skepticism and cynicism

- End of the world hysteria
- It's all about money/control
- Sky is falling panic
- Don't believe in climate change

Dismissal of climate activism

- They don't care / We don't care
- Not the other way around
- We don't need to do anything
- Nothing we can do about it

Likes and replies

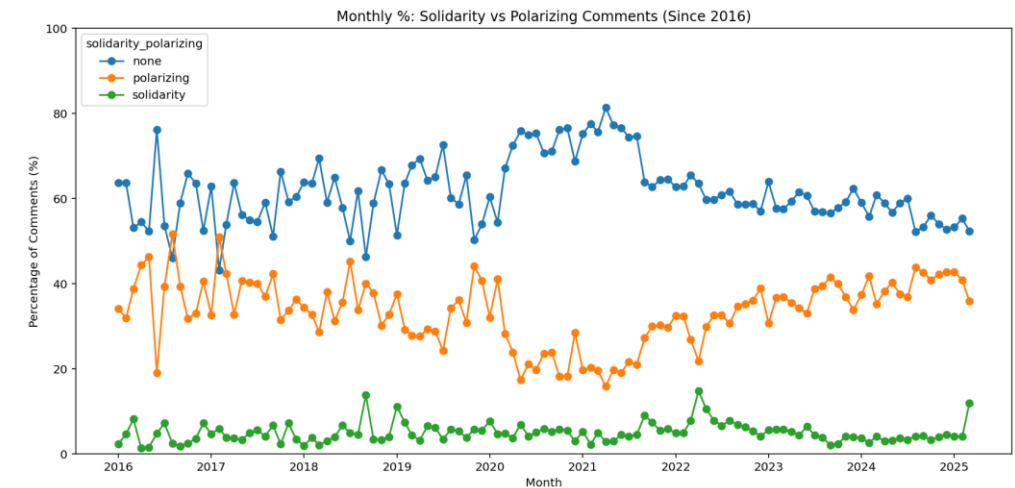
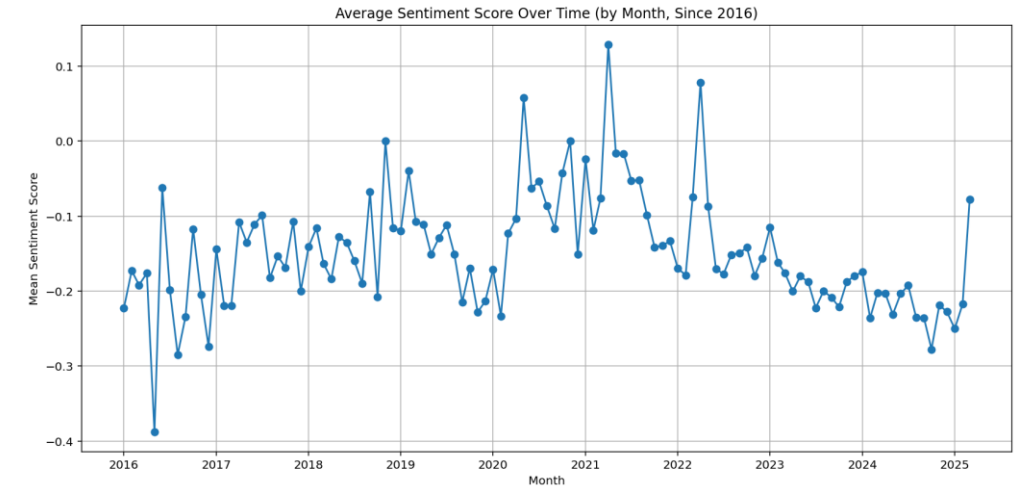
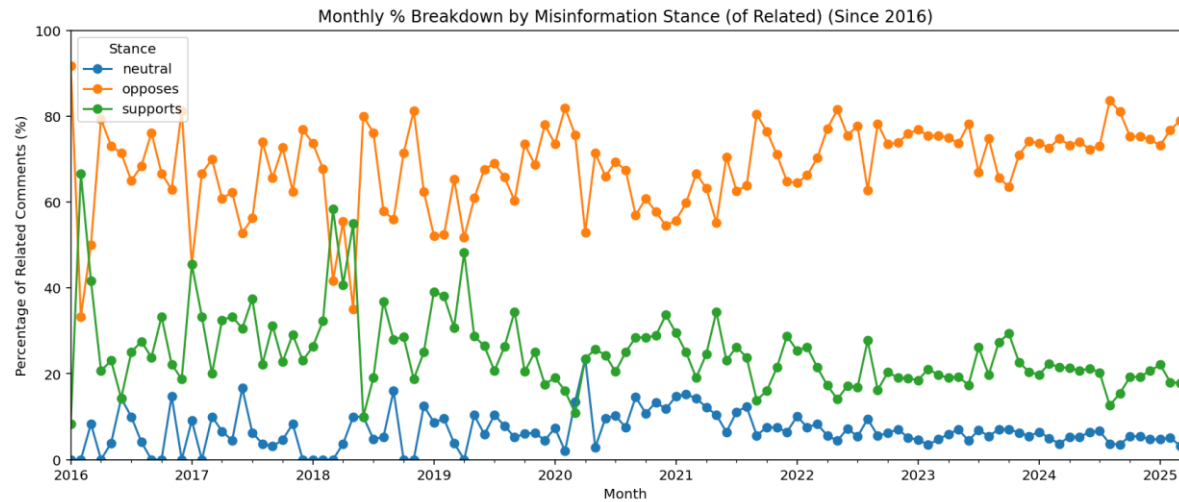
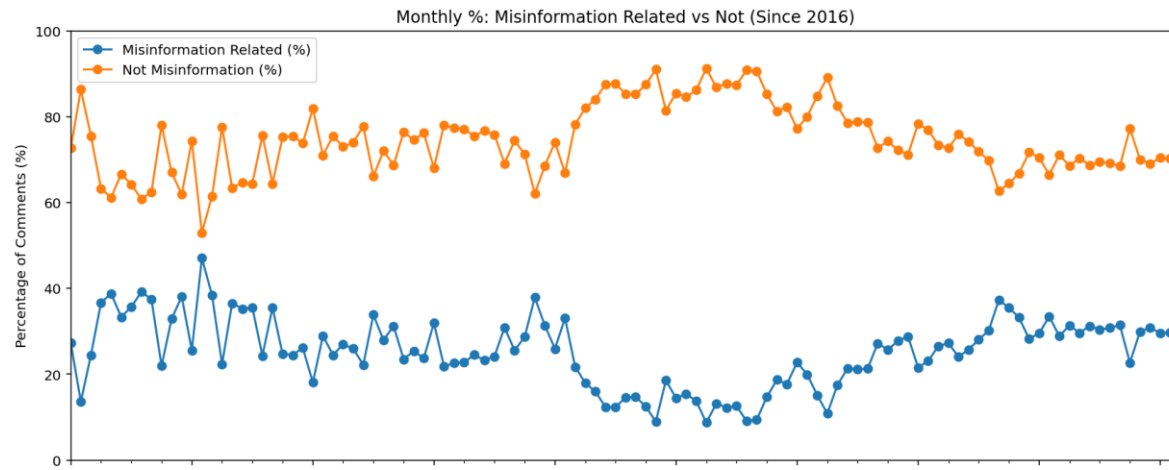
Misinformation stance			
Outcome	F	p	Group means (highest → lowest)
Likes	6.54	0.001	Opposes > Neutral > Supports
Replies	14.13	< 0.001	Supports > Opposes > Neutral
Sentiment	2704.90	< 0.001	Neutral (−0.12) > Supports (−0.46) ≈ Opposes (−0.47)

Solidarity vs. polarizing			
Outcome	F	p	Group means (highest → lowest)
Likes	13.96	< 0.001	Solidarity (9.35) >> None (4.12) > Polarizing (1.74)
Replies	6.67	0.001	Solidarity > Polarizing > None
Sentiment	16262.18	< 0.001	Solidarity (+0.26) > None (−0.11) >> Polarizing (−0.53)

Clustering

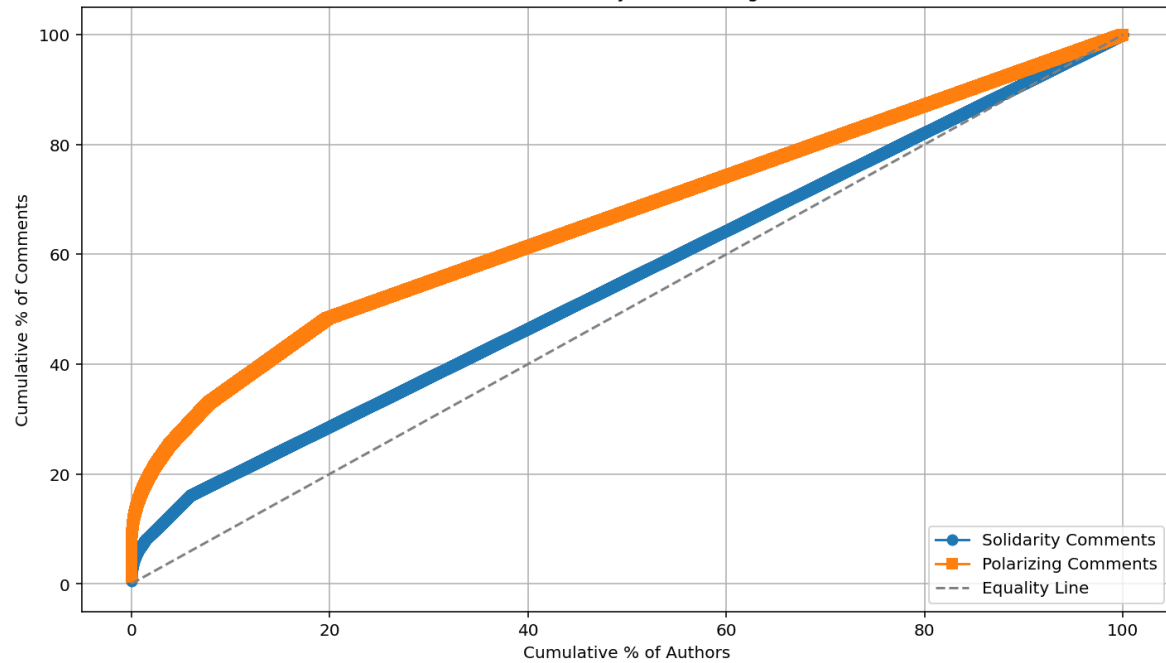
Cluster	Comments (%)	Sentiment	Likes	Responses	Solidarity_polarizing			Misinformation stance			
					None	Polarizing	Solidarity	Neutral	Opposes	Supports	Unrelated
0	2.50	-0.645	182.797	11.769	95.3	3.2	1.5	0.1	0.6	0.1	99.1
1	5.22	0.71	12.14	0.698	0	0	100	0.1	3.1	0.1	96.7
2	4.36	-0.488	0.622	0.879	7.8	92.1	0.1	0	0	100	0
3	9.84	0.48	7.257	0.609	97.1	2.9	0	0	0	0	99.9
4	19.54	0.089	1.468	0.251	100	0	0	2.4	0	0.1	97.5
5	7.53	-0.659	2.362	0.488	0	94.2	5.8	0	0	0	100
6	16.08	-0.501	1.649	0.637	15.8	83.7	0.5	4.8	95.2	0	0
7	7.92	0.766	2.748	0.224	99	1	0	0.9	4.7	1.2	93.3
8	19.60	-0.464	1.305	0.129	99.8	0	0.2	0	0	0	100
9	7.41	-0.449	1.498	0.271	0	100	0	0	0	0	100

Analysis over time

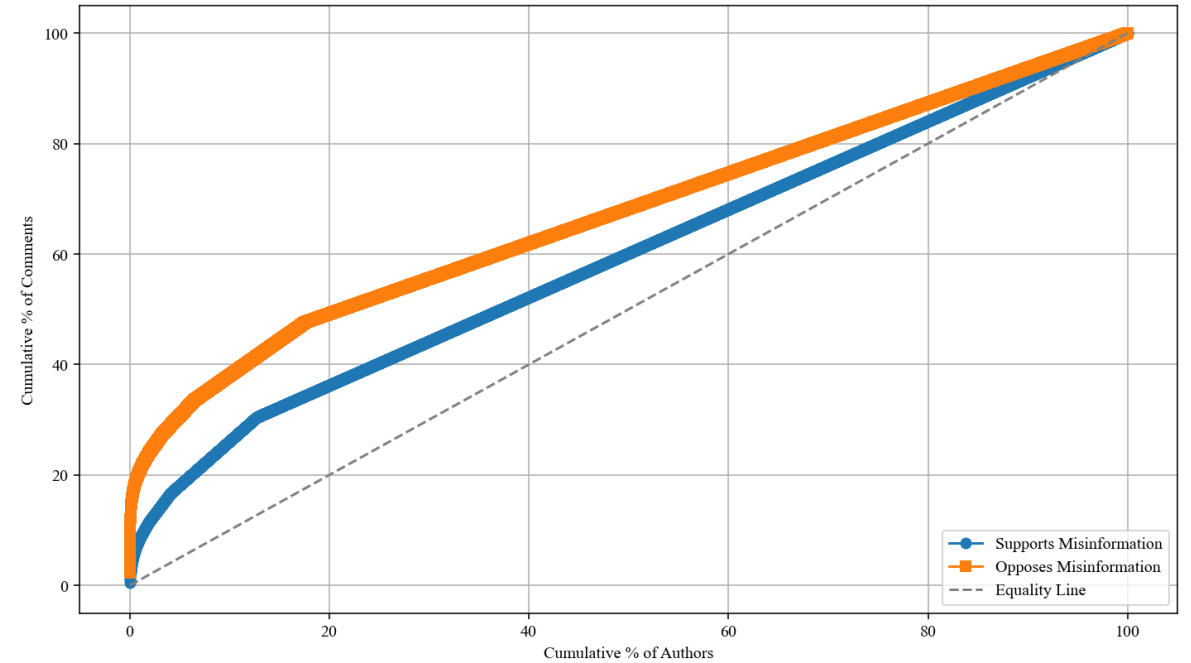


Authors

Lorenz Curves: Solidarity vs Polarizing Comments



Lorenz Curves: Supports vs Opposes Misinformation



Part 2: A focused analysis of anxiety-related comments and their social meaning

Is Anxiety Clearly Distinguishable from Other Emotions?

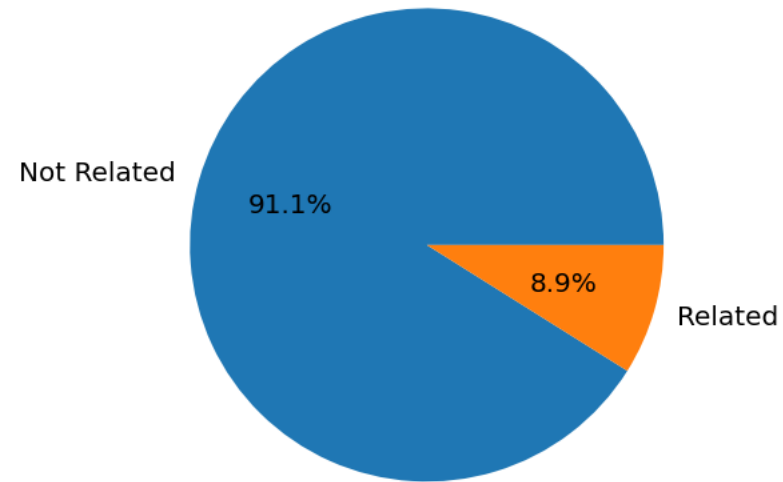
Theoretical clarity

- Anxiety is **conceptually** distinct from other negative emotions:
- **Fear** is more immediate and specific (e.g., "I'm scared of wildfires this summer").
- **Anger** involves a sense of injustice or blame (e.g., "Politicians are doing nothing!").
- **Frustration** stems from blocked goals (e.g., "Why is this taking so long to fix?").
- **Anxiety**, in contrast, is more **diffuse, future-oriented, and internalized**, often expressing worry, dread, or a sense of helplessness (e.g., "I can't stop thinking about how bad things might get").

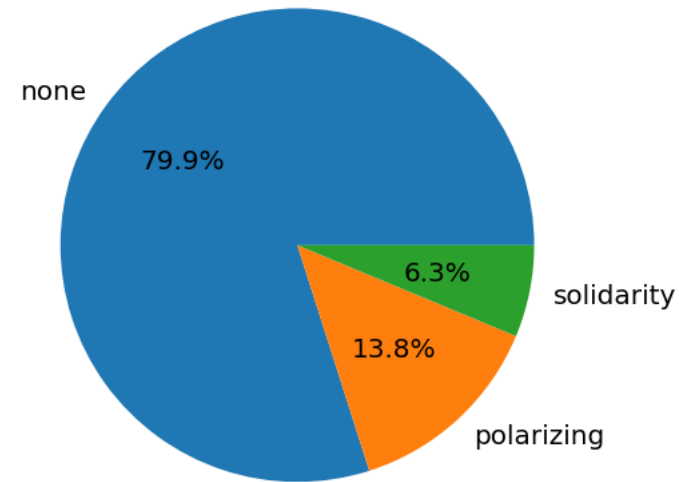
• 2. In practice

- In real-world, noisy, user-generated text **anxiety is often blended** with fear and frustration, making it tricky to isolate.
- People may not use the word *anxiety* directly, but instead use **signals** like:
 - "I can't sleep at night thinking about this."
 - "This gives me a pit in my stomach."
 - "I'm constantly worried about the future."

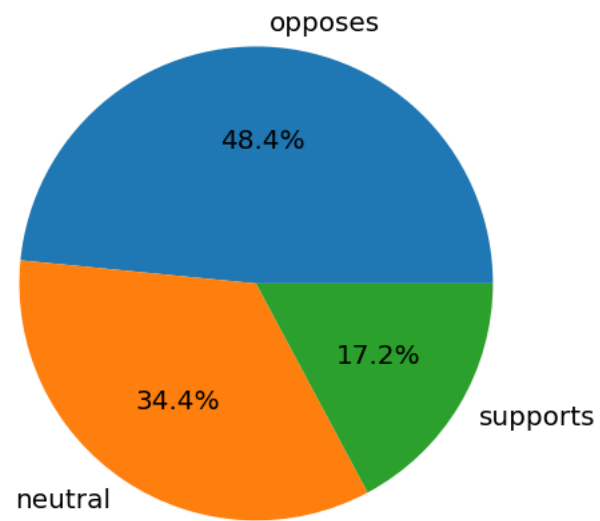
Misinformation Related Distribution



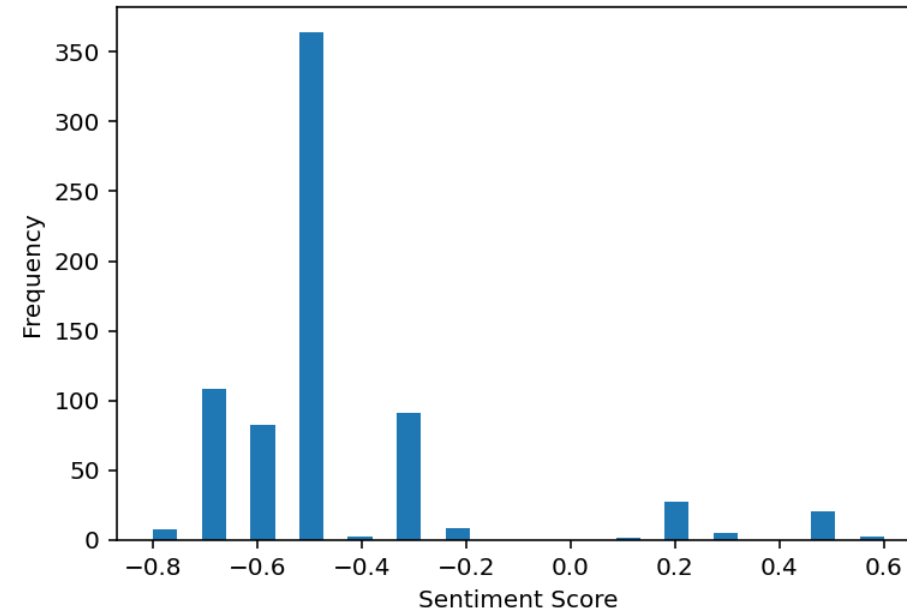
Solidarity Polarizing Distribution



Misinformation Stance Distribution (Related Comments)



Sentiment Score Distribution for Anxiety Comments



0.21% of all comments.

Like count (from 0 to 1881) with mean 8.37 and std. 91.64.

Response count (from 0 to 57) with mean 0.74 and std. 3.83.

Anxiety comments vs. other comments

Sentiment score

- Group comparison: The Mann–Whitney U test is highly significant ($p < .001$), telling us the distribution of sentiment scores for anxiety comments is different from that of all others.
- Effect size: Cohen's $d = -0.639$ is a moderate-to-large effect, indicating anxiety comments are on average notably more negative in sentiment than other comments.

Like count

- Group comparison: Mann–Whitney $p = .065$ so we do not have evidence of a reliable difference in like counts between anxiety comments and other comments.

- Effect size: Cohen's $d \approx 0.004$, essentially zero, confirms there's no meaningful difference in how much these two groups get liked.

Number of responses

- Group comparison: Mann–Whitney $p = .041$ is just under .05, technically significant.
- Effect size: Cohen's $d \approx 0.009$, basically zero.

Misinformation related

- Contingency: Anxiety comments are misinformation-related in $64/717 \approx 8.9\%$ of cases; the rest of the corpus is misinfo-related at $72\,421/333\,991 \approx 21.7\%$.
- Chi-square: $\chi^2 \approx 67.9$, $p < .001$ confirms a real difference in proportions.

- Effect size: Cramér's $V = 0.014$ is extremely small.

Misinformation stance

- Chi-square: $\chi^2 \approx 105.8$, $p < .001$ indicates a group difference in stance distributions.
- Effect size: Cramér's $V = 0.018$ — still vanishingly small.

Solidarity / Polarizing

- Anxiety comments are coded as “none” $\sim 80\%$, “polarizing” $\sim 14\%$, “solidarity” $\sim 6\%$; for other comments it's $\sim 62\%/32\%/6\%$.
- $\chi^2 \approx 115.2$, $p < .001$ shows a significant distributional difference, but Cramér's $V = 0.019$ again tells us the magnitude is trivial.

Conclusion

- **Sentiment is the lone standout:** Anxiety-labeled comments are markedly more negative than others, whereas every other dimension shows negligible effect sizes.
- **Polarization outweighs solidarity:** Polarizing comments constitute 32.4% of the discourse, compared to only 5.8% solidarity comments.
- **Engagement favors solidarity:** Despite being fewer, solidarity comments receive more likes, replies, and higher sentiment scores, indicating stronger positive audience engagement.
- **Voices are concentrated:** A smaller group of users drives more polarizing content.
- **Echo chambers confirmed:** The solidarity share shows a flat, stationary trend, suggesting a stable echo chamber – those who express solidarity keep doing so at consistent rates, bouncing back when their presence dips.
- **Polarizing behavior also stable:** The polarizing share is similarly flat and even less volatile, pointing to a core group of persistent polarizers.
- **No drift, no convergence:** Over time, the relative sizes of the solidarity and polarizing groups remain constant, neither converging nor diverging oscillating around fixed means.
- **Key takeaway:** Climate discussions show no sign of becoming more unifying or divisive. Instead, they reflect enduring filter bubbles where each camp maintains its position – a persistent dual-bubble dynamic.

Thank you!

